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ABSTRACT

Guidelines and suggestions for introducing energy education into classrooms are provided in this booklet. The first section discusses available resources and ways to use them. These include: (1) community resources (museums, libraries, county extension services/planning offices); (2) organizations and institutions such as environmental groups, utilities/fuel companies, architectural firms, and others; (3) government resources; (4) human resources; and (5) material resources (bookstores, magazines, and federally funded materials). The second section focuses on strategies for using the resources, including organizing a course, establishing a resource center, and building and using alternative energy models. These models include a solar hot water heater, parabolic solar furnace, fresnal lens, solar electrical device, savonius rotor and wind charger, and a hytroturbine. Four sample energy education course outlines are also included. (JN)

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# Developing Energy Education Curriculum

## Inservice Series #2

## INSERVICE PROGRAM

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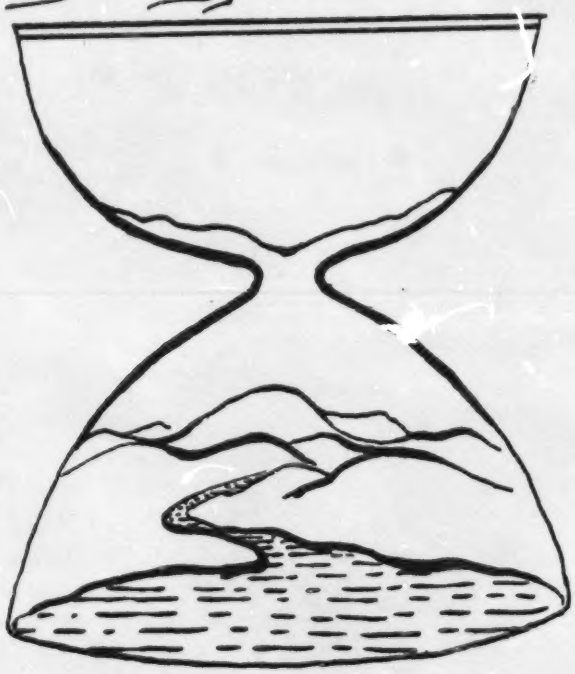
INSERVICE SERIES #2

# Developing Energy Education Curriculum



Funded by a grant from the Massachusetts Executive Office of Energy Resources, 1980.

# Acknowledgements

In the laws of thermodynamics, every time energy is converted from one form to another, energy is lost. In the laws of teaching, everytime a teacher shares an idea, new ideas are created. This booklet is dedicated to the teachers in the schools of the Hampshire Educational Collaborative who have shared with other teachers much time, knowledge, and enthusiasm for the teaching of energy education.

Our special thanks go to the core teachers who planned and taught the T.E.A.M. workshops:

*Shaun Bresnahan, Social Studies Teacher, Belchertown Jr./Sr. High School;*

*Patrick Leighton, Science Teacher, Amherst High School;*

*Fred Morrison, Elementary Sciences Coordinator, Northampton School System;*

*Jean Murray, Industrial Arts Teacher, White Brook Middle School, Easthampton;*

*David Rainaud, Math Teacher, Belchertown High School;*

and to the administrators and advisors of the T.E.A.M. grant:

*Mary Bleckwehl, Massachusetts Executive Office of Energy Resources, Springfield Office;*

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*Peg McDaniel, Librarian, Hitchcock Center for the Environment, Amherst;*

*Cecelia Scaife, Inservice Development Center Director, Hampshire Educational Collaborative, Northampton; and*

to the staff of the Energy Management Center, Pasco County Schools, Pasco County, Florida, whose IVC validated materials included blueprints for alternative energy models.

Dr. Mary Alice B. Wilson
Inservice Director
Hampshire Educational Collaborative

Elizabeth Yasi
Editor

Mary Ellen Chantry
Graphic Artist

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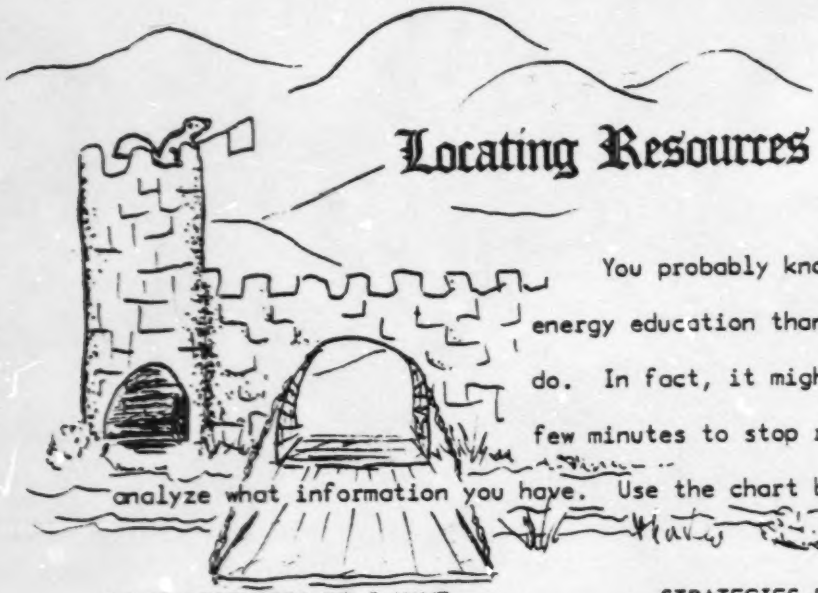
# Introduction

For the past two years, we at the Hampshire Educational Collaborative (HEC) have offered inservice courses in energy education. At the end of the first course, the teachers involved formed a support group so they could continue to meet to discuss ways to introduce energy education in their classrooms. Discussions at support group meetings often became strategy sessions as teachers planned how they could get more teachers involved in energy education. A result of those sessions was an expressed need teachers wanted practical, concrete models that could both demonstrate energy concepts and inspire teachers.

We proposed a grant, Teaching Energy with Alternative Models (T.E.A.M.); it was funded by the Massachusetts Executive Office of Energy Education as a half-year project in August, 1980. With the help of blueprints provided by an ESEA Title IVC Project in Pasco County, Florida, teachers built six energy models. All modifications of the Pasco designs, T.E.A.M. built alternative energy models are easy to transport, are used in both elementary and secondary classrooms, and serve as concrete introductions to energy education for students and teachers alike.

This booklet is meant to serve three audiences. For teachers who can borrow alternative energy models from HEC, here are ideas for activities and demonstrations. For teachers without access to

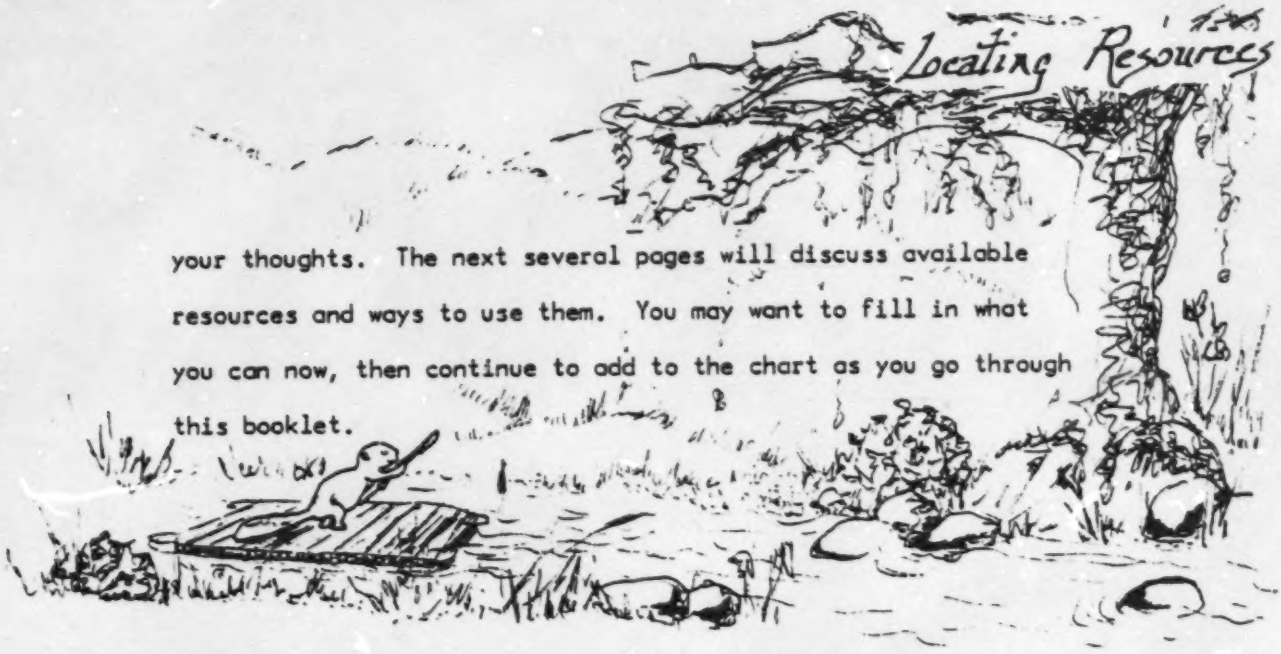
our alternative energy models, this booklet offers help in locating resources for creating energy education curriculum. For our most important audience, students, we have tried to assemble these materials in a creative way with the hope that the energy expended will be transformed into human dynamism -- into energy consciousness.



# Locating Resources

You probably know more about energy education than you think you do. In fact, it might be worth a few minutes to stop right now to analyze what information you have. Use the chart below to organize

| WHAT RESOURCES DO I HAVE TO TEACH ABOUT ENERGY? | STRATEGIES FOR USING RESOURCES |
|---|---|
| *Personal Resources:* | |
| *Community Resources:* | |
| *Organizations and Institutions:* | |
| *Human Resources:* | |
| *Material Resources:* | |




your thoughts. The next several pages will discuss available resources and ways to use them. You may want to fill in what you can now, then continue to add to the chart as you go through this booklet.

| WHAT PROBLEMS DO I FORESEE? | STRATEGIES FOR PROBLEM SOLVING |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |

*Community Resources:*

**Museums** — science museums, historical museums. Some town and private museums have excellent demonstrations and resource people.

**Libraries** — town, city, college, community and resource centers. Libraries are useful both for books and for people who are knowledgeable about the network of libraries and resource centers in your area.

**County Extension Services & Planning Offices.** These have been very active in energy conservation issues.

*Organizations and Institutions:*

**Environmental Groups** — local, state and national. In Massachusetts, the Audubon Society has two excellent resource libraries -- in Lincoln and Hampden.

**Utilities and Fuel Companies** — These have a variety of excellent resources, including posters and brochures. Most utility companies have a staff knowledgeable about building conservation issues.

Alternative Energy Businesses;
Architectural Firms;
Alternative Lifestyle Magazines;
Cooperatives.

# Locating Resources

*Government Resources:*

**State Energy Office** — Each state has an energy office or department. The federal government has an energy department (for the time being) which has regional offices. They have resources and, equally important, know where resources are.

**U.S. Government Printing Office,** Washington D.C. 20402. A wonderful source of materials!

*Human Resources:*

**Teachers and Administrators** — There are many teachers (in your own school system and nearby school systems) who are already teaching energy education in their classrooms -- probably the best resource on how to do it!

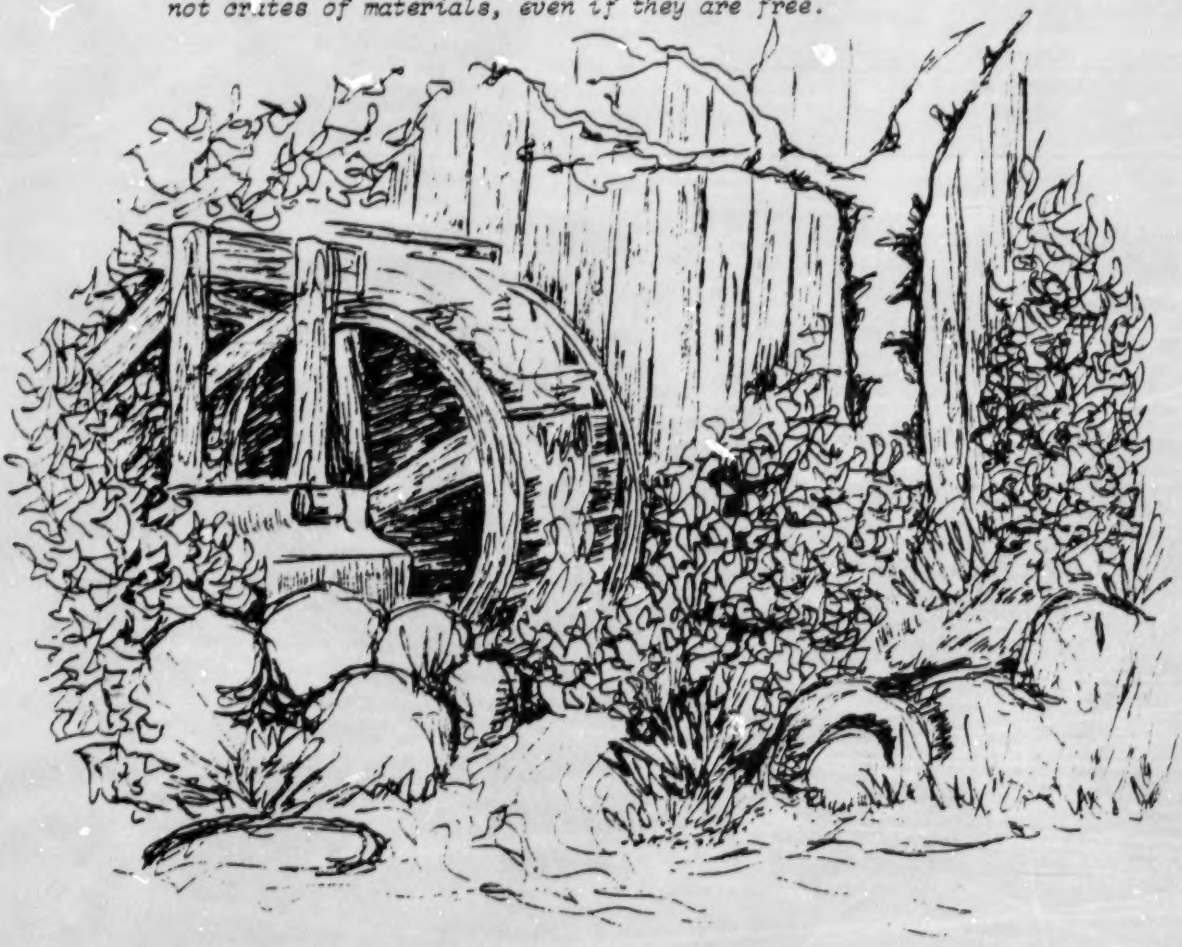
*Material Resources:*

**Bookstores** — Almost all bookstores have energy sections. There are probably larger sections in paperbook stores, in stores focusing on alternative lifestyles and do-it-yourself approaches. Some publishing houses are producing large numbers of energy-related books. Spend some time with the subject index to Books in Print.

**Magazines** — There are a number of alternative energy magazines or regional magazines (e.g., New Roots in western Massachusetts) which deal with energy issues.

**Federally Funded Materials** — There have been a number of federally-funded energy education materials developed. Contact funding agencies (like the Department of Energy) or do an ERIC search.

*Remember, materials are always developed for a specific learning situation and may not meet other needs. Order examination copies, not crates of materials, even if they are free.*



# Strategies for Using Your Resources

## *Organize a Course*

Your search for information and materials may provide the groundwork for an inservice course in energy education. Sharing information with other teachers can not only help one in his or her own curriculum development, but also build enthusiasm for teaching about energy. In the following pages, you will find information on locating funding sources and contracting speakers. In addition, offered for your consideration are the formats of the four energy courses supported by HEC. These may act as guidelines for new course sequences, or may serve as examples of how community professionals and businesses have helped in energy education for teachers.

Getting an Inservice Course Funded. You may have funding sources for inservice courses within your school system. Obviously, that is the first avenue you should explore.

There are governmental and private organizations which will fund an inservice course in energy. The easiest, by far, for teachers in Massachusetts to receive funding from is the Commonwealth Inservice Institute (CII): CII has funds specifically set aside for energy education.

CII funds may be used for courses which:

- Are designed for and by school staffs. (So be sure to include other potential participants in your planning);
- Are designed to improve classroom teaching or specific educational services;
- Are actively supported by the administration of the school system. (Keep administrators involved in planning and as participants in courses);
- Meet local needs and promote state and federal priorities.

CII forms ask for background information on the need for the proposed program, its objectives, activities, anticipated budget and outcome, a list of participants, and the signatures of appropriate school system administrators. Forms and information are available from your regional education center. Work with your regional CII representative to insure that forms are prepared correctly and that funding is not delayed.

For teachers living outside Massachusetts, or for those in Massachusetts whose CII regional funds already have been allocated, funding may be sought from other Commonwealth Inservice Institute related funds, the United States Department of Energy, or local charity, environmental and business groups. If all else fails, courses can be self-supporting, fees can be charged. If you go that route, contact your local adult education center. People there may do bookkeeping and advertising for you.

Finally, however you fund your course, you may want to establish ties with a local college or university so you can offer graduate credit.

Getting Speakers. The resources we've discussed are all good sources of speakers. Besides those sources, brainstorming sessions with potential course participants should provide additional names. Check you local papers for energy article bylines. Those writers can put you in touch with local experts. Remember that the best speakers are those who understand that teachers are not going to lecture to their students. They do not lecture to teachers. Speakers with an ability to provide simple illustrations of complex concepts are ideal.

Contracting Procedures. Contracting procedures vary with your funding source, but whatever system you use, make sure to include in your contract with each (paid or unpaid) speaker:

a. map to the place the course will be held;

b. time;

c. cancellation procedures;

d. a list of equipment or materials to be used and who is providing them;

e. topic and approach to be used (e.g., lecture, demonstration, slide show, workshop);

f. attached statement about the course goals, objectives, and syllabus, and about your school system or organization. We, for example, attach the statement that is on the top of the next page to our contracts;

g. amount of payment and when payment will be made; and

h. contact person's name, and home and work telephone numbers.

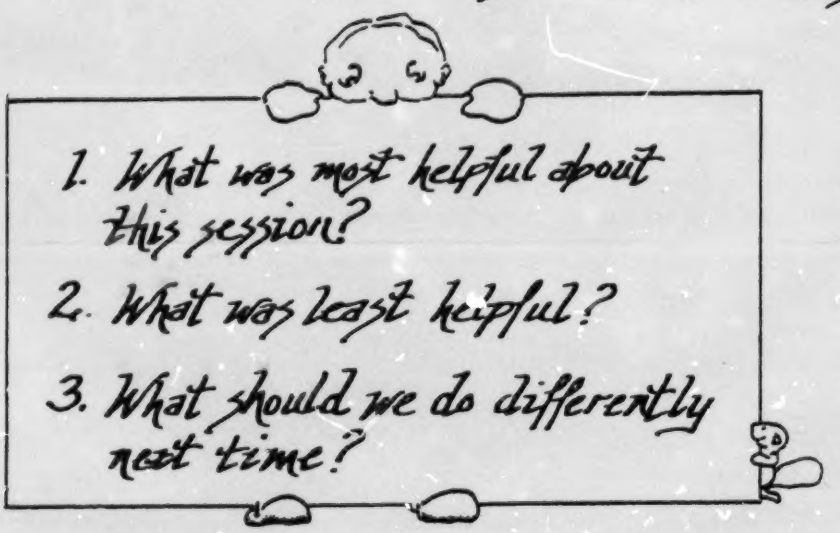
Course Coordinator. Once speakers are selected, you will need one person responsible for coordinating the course. Although

*As you plan your presentation, please keep in mind that the teaching process which you use is as important as the material you present. The goals of the inservice programs offered through the Hampshire Educational Collaborative Inservice Program are:*

1. *To provide an opportunity for school staff to adequately explore a topic or skill which they have determined to be important.*
2. *To model the best available techniques of teaching/learning.*
3. *To provide a creative, low-risk opportunity to experiment with and develop skills in an area being studied.*
4. *To develop a support system which will continue after a given program to assist staff in implementing whatever strategies they develop in their own schools.*
5. *To develop a cadre of experienced resource people who can jointly assist additional staff within their own school or in other schools to become skilled.*

most work can be done with a committee, one person (the course coordinator) must be responsible for handling all contracts, attending all sessions, monitoring participants' project work, and overseeing the evaluation process.

Evaluation. We use a very simple evaluation form which we distribute and collect at each session. The information gathered is used immediately to make adjustments in the organization of the course.




Four Course Formats. Course organization is, more often than not, a concession of logical sequences to speaker availability. The norm applies to the four course sequences here. It is, therefore, unlikely that your needs assessment or speaker availability will permit you to duplicate our courses. There are issues you might want to discuss which we never raised; for example, we have never offered a session devoted entirely to school energy conservation. These sequences, then, should be regarded as illustrations.

Funded by the HEC Inservice Development Center (ESEA, IVC) in the fall of 1979
Course Coordinator: Mary Bleckwehl

| Week | Topic |
|---|---|
| 1 | Personal Effects of the Energy Crunch (led by course coordinator) |
| 2 | Historic Backaround (author of energy materials) |
| 3 | Conventional Energy Gernerators: How They Work (utility company) |
| 4 | Building Models of Conventional Energy Generation (course coordinator) |
| 5 | Resources In Energy (environmental center librarian) |

| Week | Topic |
|---|---|
| 6 | Alternative Energy Generators: How They Work (alternative energy company) |
| 7 | Alternative Energy Model Building (course coordinator) |
| 8 | Energy Conservation (audit team) |
| 9 | Conservation Activities for the Classroom (course coordinator) |
| 10 | Local Energy Use (county planning office) |
| 11 | Dramatizing Energy in the Classroom (puppet theatre) |
| 12 | Resource Day: Sharing of Curriculum Projects (participants) |

2

Funded by the HEC Inservice Development Center (ESEA, IVC) for teachers in Northampton and Easthampton in the spring, 1980
Course Coordinator: Fred Morrison

| Week | Topic |
|---|---|
| 1 | Overview of Course: Overview of Energy (course coordinator and author of energy materials) |
| 2 | What Can A Teacher Do? (teacher active in energy education) |
| 3 | Home Energy Management (audit team) |
| 4 | Visits to Alternative Energy Sites |
| 5 | Oil Burner Efficiency: Case Study in Conservation (oil company) |
| 6 | Curriculum Development Session (course coordinator) |
| 7 | Nuclear Energy (panel) |
| 8 | Solar Energy Overview (solar resource center) |
| 9 | Wind Energy: Geothermal Energy (college professor) |
| 10 | Renewable Energy Models (science coordinator) |
| 11 | Curriculum Development Session (course coordinator) |
| 12 | Locating the Resources (librarian, environmental resource center representative, puppet theatre) |

# 3

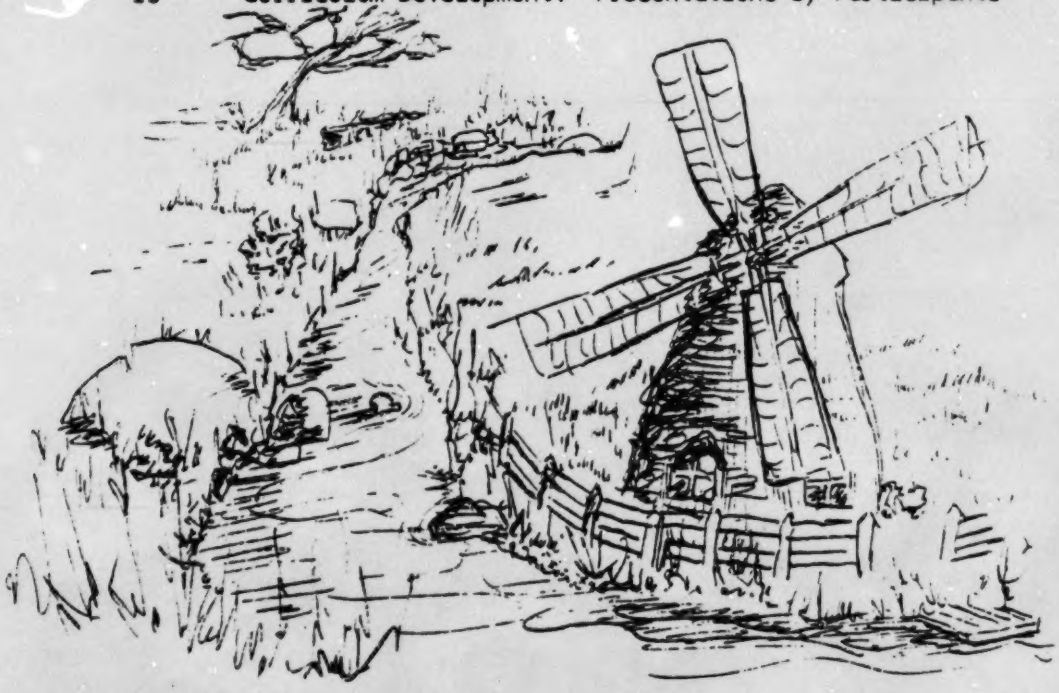
Funded by the HEC Inservice Development Center (ESEA, IVC)
for teachers in West Springfield
Course Coordinator: Shaun Bresnahan

| Week | Topic |
|---|---|
| 1 | Course Expectations -- Slide Show on Classroom Activities (course coordinator) |
| 2 | Conservation: Residential Energy Audit Process (audit team leader) |
| 3 | Overview of Energy Alternatives (author of alternative energy materials) |
| 4 | Wind Energy: Commercial and Residential Potential (builder of windmills) |
| 5 | Building Inexpensive Classroom Models for Wind Energy (science coordinator) |
| 6 | Solar Energy: Focus on Solar Greenhouses (environmental resource librarian) |
| 7 | Learning About Local Resources -- Libraries and Local Resource Centers (environmental resource center librarian) |
| 8 | Solar Systems -- How Do They Work? (contractor) |
| 9 | Curriculum Development: Putting an Inquiry-Based Unit Together (course coordinator) |
| 10 | Hydroelectricity, Fossil and Nuclear Fuel Economics (utility company) |
| 11 | Field Trip to Hydroelectric Plant |
| 12 | Energy Resources Available from the Government (government representative) |
| 13 | Review, Presentation, and Analysis of Teacher-Prepared Packets (course coordinator) |

# Developing Energy Education Curriculum

Funded by the Massachusetts Executive Office of Energy Resources (T.E.A.M.) in the fall, 1981
Course Coordinator: Shaun Bresnahan
(All sessions taught by teachers already experienced in energy education)

| Week | Topic |
|---|---|
| 1 | How to design your Curriculum |
| 2 | Site Visit: Hydroturbine, Solar Greenhouse, Solar Home |
| 3 | Definition of Energy |
| 4 | Field Trip: Alternative Energy Store |
| 5 | Wind Energy: Principles and Model Building |
| 6 | Solar Principles and Models |
| 7 | Energy Curriculum: Review of Available Materials |
| 8 | Water Power: Principles and Models |
| 9 | Building Models with Inexpensive Materials |
| 10 | Solar Hot Water Systems: Principles and Models |
| 11 | Home Conservation: Principles and Learning Packets |
| 12 | Curriculum Development: Presentations by Participants |
| 13 | Curriculum Development: Presentations by Participants |



## Establish a Resource Center

If you offer an inservice course in energy education, you may want to set up space for teachers to meet to discuss curriculum development, to store course materials, or to house resource files. Even if you are not involved in inservice planning, a resource center for energy education can be a place to share ideas and find impetus to introduce energy curriculum into classrooms.

Resource Centers in schools come in all shapes and sizes. They can be:

LIBRARIES with reference books, curriculum materials and some confortable chairs.

WORKSPACES for teachers to make materials and pick up recycled materials for classroom projects.

STOREROOMS full of alternative energy models or other paraphernalia which can be used in the classroom.

COMPUTER TERMINALS which have retrieval information systems. Information can include people, organizations, and materials.

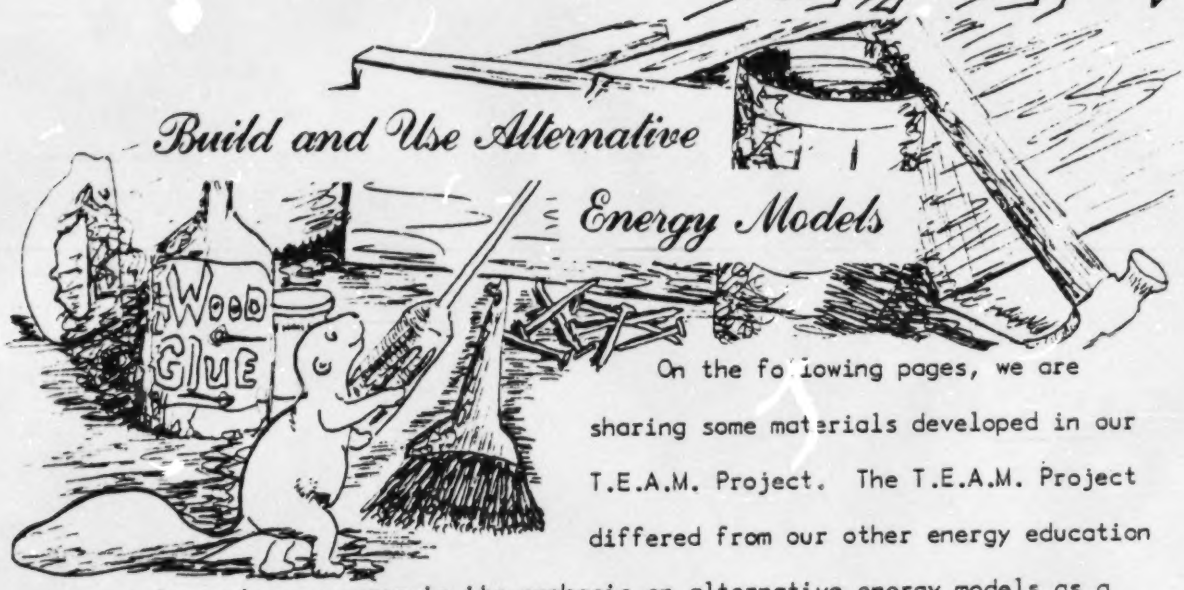
COMFORTABLE CORNERS in teachers' rooms, libraries, even closets, where people meet to share ideas.

Although "Resource Center" is loosely defined, if it is going to last, its advocates must be defined. There needs to be someone or some group responsible for a Resource Center's continued existence.

If you are interested in setting up an energy education

resource center, we would be happy to have you visit our center in Northampton, or we may be able to tell you about another in a convenient location. In addition, if you have a computer terminal or microcomputer, we can send you our computer retrieval programs. We have two programs written in BASIC. One is for the University of Massachusetts' CYBER computer; the other is for our APPLE II. You are welcome to copies of both.

# Build and Use Alternative Energy Models

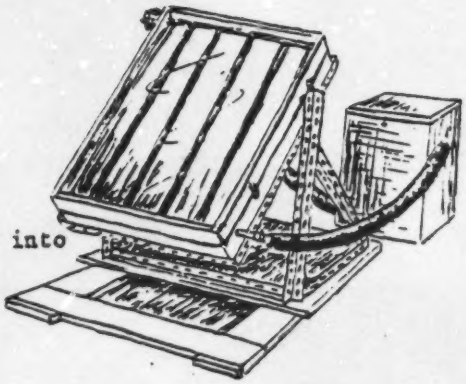



On the following pages, we are sharing some materials developed in our T.E.A.M. Project. The T.E.A.M. Project differed from our other energy education inservice programs in its emphasis on alternative energy models as a focus of energy teaching in the classroom. Alternative energy models are not essential to the teaching of energy, but they help make it fun. We got the ideas for our models and blueprints for a number of them from the ESEA Title IVC Project in Pasco County, Florida. For more information from that project, write Energy Management Center, P.O. Box 190, Port Richey, Florida 33568.

The alternative energy models described here have been used in many ways. Individually, teachers work with them to develop understandings of forms of alternative energy. Groups of teachers work with a model, together determining the implications of the form of energy it demonstrates and developing appropriate classroom activities. Teachers use models with students, teaching them the potential of alternative energy sources. Finally, students demonstrate the models to other students, parents, and community members.

Accompanying the illustrations and descriptions of models are suggestions for activities. These are just the beginnings of the many ways you can use these and other alternative energy models.

Solar



heats water by turning light energy into heat through metal plates

## Solar Hot Water Heater —

Although awkward to transport, this is our most popular model. It needs at least an hour of sun time: the more time you have, the more heat will be generated. Our model has thermometers on the top and bottom of the tank so that students can record changes and observe thermal convection (which thermometer will record the higher temperature?) Our tank is made of wood-lined-with- styrofoam.

Although this system is not identical to most of the hot water systems visible on the sides of houses these days, it operates under the same principles. Most domestic solar hot water systems heat pipes filled with anti-freeze. These pipes run through the hot water tank heating the water by heat exchange. Students, however, should not have much trouble understanding why a plain hot water system will not work during a New England winter. (Resist the temptation to demonstrate the effect. If you leave the model out overnight to freeze you may rupture all the piping.)

One could transfer heated water into insulated and uninsulated

containers to measure the importance of insulation (an excellent inquiry activity on the importance of conservation). Students can work with the angle of the panel: older students can work out the mathematics of the best angle for their own latitude (or for anywhere else, for that matter). Younger students can develop offshoot experiments testing the importance of the black paint on the solar panels. Coffee cans painted different colors and filled with water, some thermometers, and a recording sheet should be all you need.

## Solar

Light striking the mirror-like surface is reflected onto a cooking bar just above the surface

## Parabolic Solar Furnace

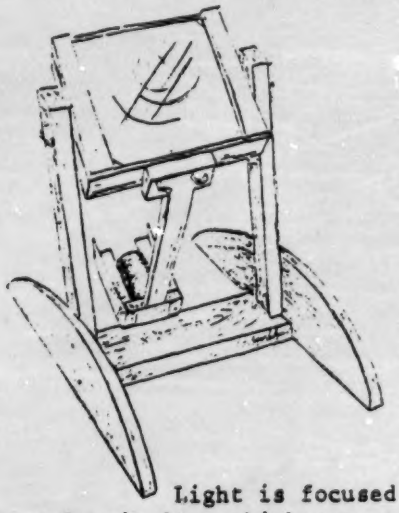
CAUTION: Concentrated solar heat is HOT and the light is BRIGHT. This is, of course, a characteristic of solar heat exploited in this model. Be prepared, however, with well-insulated cooking or construction gloves and monitor the reflector's use so that students are not looking directly into the light.

This is an excellent model for study of the changing angle of the sun (between seasons and throughout the day). It, also,

demonstrates the, perhaps, most difficult concept for most of us to accept: the relationship between outside temperature and solar heat is relatively minor. For older students, the shape of the parabola and the importance of the shiny surface of the reflector open up a variety of possible experiments with cardboard and foil.

The bar where the heat is concentrated can be used for direct cooking of marshmallows, apple slices, and hot dogs, and for hanging a pot of liquid on. Never use a flammable liquid like cooking oil! You will get a more dramatic demonstration than you need.

Solar



Light is focused through a plastic lens which operates much like a magnifying glass.

Fresnel Lens

Those of us who entertained ourselves in our youths with a magnifying glass and a pile of leaves already understand the relationship between concentrated sunlight, heat, and danger. This model needs very careful monitoring. The heat generated is spectacular, as is the light. Keep this model covered with cardboard whenever it is not in use. Never leave students unattended. Never

focus this lens on anything that might explode. Wear insulated gloves when working with any materials being held at the focal point.

This model, of course, demonstrates how powerful a small amount of sunlight can be. You can make designs on wood (using a woodburning process) -- an exciting way to compare the properties of soft and hard woods. You can boil water (don't fool around with other liquids and make sure that the container is not painted with flammable material). The sun angle and potential use activities (including incinerating wastes) suggested for use with the preceeding solar models can, also, be used with this model. One advantage of the speed with which this model produces heat is that every student can experiment with it in a limited time period.

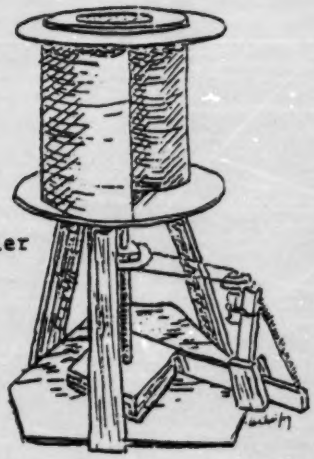
Solar

where light energy is changed into electrical energy. Voltage of the panel of cells reaches eight volts on a sunny day

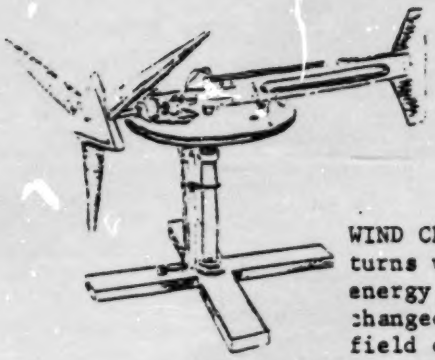
## Solar Electrical Device—

This is a wonderful and very safe model. Students can design different disks to put on the rotating arm of the motor, and can change the effect of the pattern by adjusting the angle of the cells or, even, by shading the cells with their hands. Discussions of electrical storage issues and potential use issues can complement a unit centered on the photovoltaic cell.

## Wind



SAVONIUS ROTOR -
it is less efficient than a propeller model, but will work in low wind



WIND CHARGER -
turns wind (kinetic energy) into mechanical energy, which turns the shaft and is changed to electricity in the magnetic field of the generator

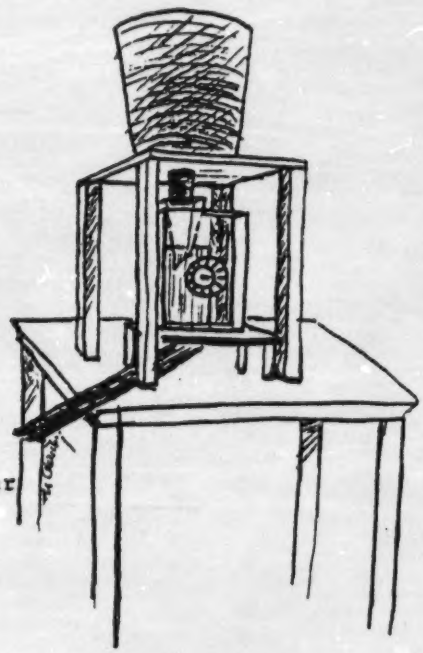
## Savonius Rotor and Wind Charger

Both of our wind chargers are designed to demonstrate the generation of electrical power, but the use of wind for generating mechanical power (especially the ubiquitous wind blade windmill which pumped well water all over the west) can also be demonstrated. Since the moving parts of these machines are exposed, students should be supervised at all times. They might spend some time themselves establishing safety rules.

Demonstration of this model is an especially good opportunity to study the importance of site selection (both location and height from the ground). No matter how small your school grounds, it has more and less windy spots. With the help of an industrial fan (the

lighter fans will not do much), you can develop a variety of indoor experiments.

Hydro



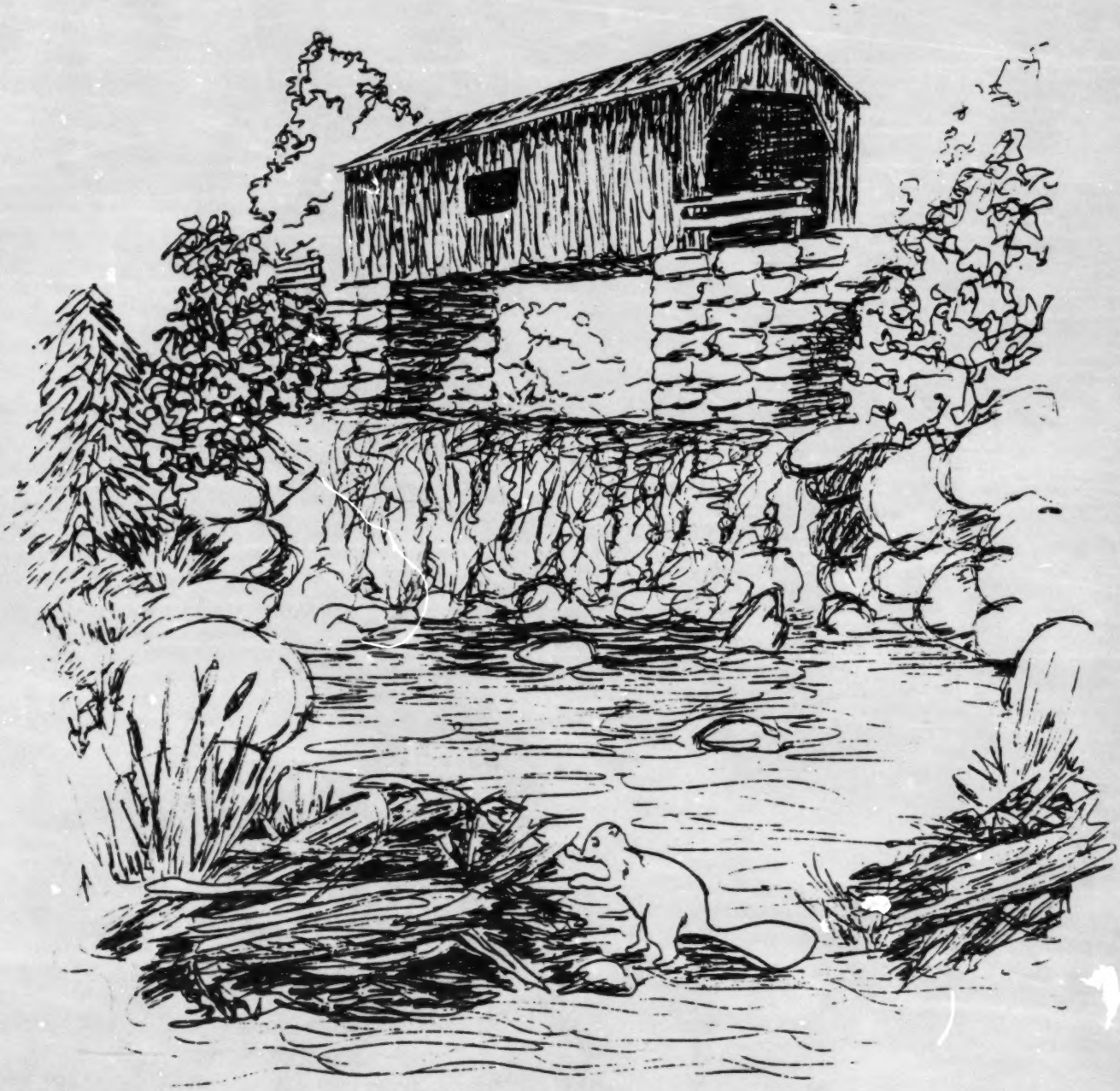
water flows into a plastic turbine (water wheel), and the turbine shaft drives a small motor

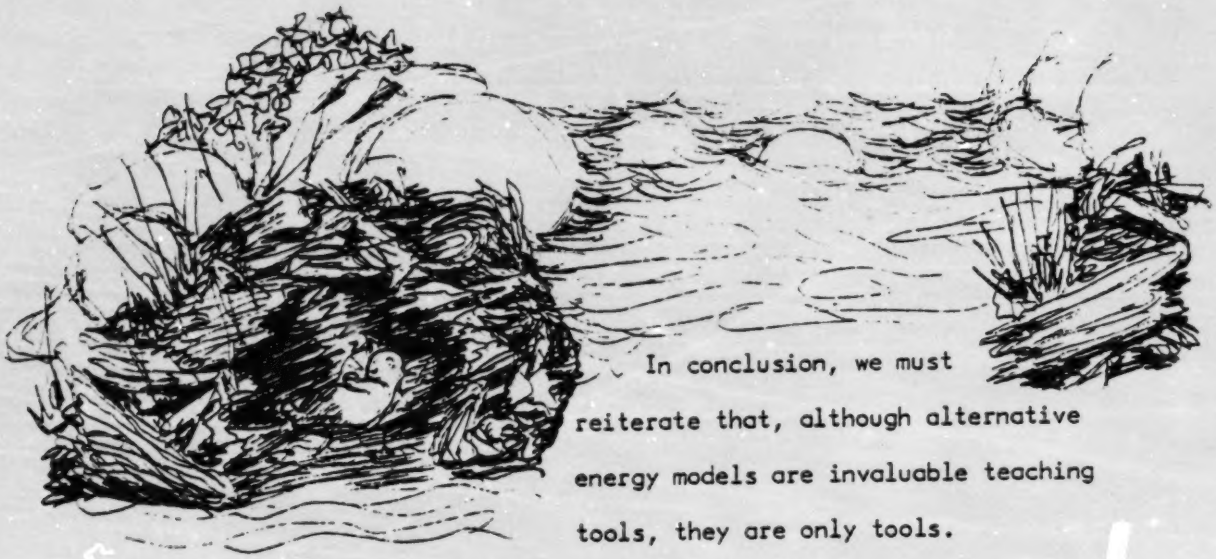
Hydroturbine—

This model is especially useful in helping students (and adults) understand the process by which water can generate electrical or mechanical energy. On our model, the height of the source (bucket) and, therefore, the force of the water can be varied.

Given the historical importance of water power in New England, it may be difficult to get this model away from the history teacher. Historical studies of the designs of water wheels and their economic effects are great fun. Water power, generating both electrical and mechanical power, is still in use throughout New England. Research projects can be assigned in many areas: efficiency of water power, comparative energy, environmental issues, weather-related issues, power dams, power (as different from transportation) canals, and legal issues. If you live near industries presently or formerly

powered by water (and if you live in New England, you do), this is a great topic for oral history interviews.





In conclusion, we must reiterate that, although alternative energy models are invaluable teaching tools, they are only tools. Developing curriculum and taking an active part in the energy education of students requires a teacher's skills, resourcefulness, and initiative. We hope we have provided some direction to you where ever your adventures in energy education may take you.

We would love to hear about your work, and your thoughts about ours.

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